Permit : 150120
AppID : 4096698

SCS ENGINEERS

Air Permit Application for the 91st Avenue Biomethane Facility

Presented to:

Maricopa County Air Quality Department
1001 N. Central Ave. Phoenix, AZ 85004
(602) 506-6010

Prepared for:

Ninety-First Avenue Renewable Biogas LLC
111 Speen Street, Suite 410
Framingham, MA 01701

Prepared by:

SCS ENGINEERS
4222 East Thomas Road, Suite 310
Phoenix, Arizona 85018
(602) 840-2596

October 14, 2015
File No. 01203117.20

Offices Nationwide
www.scsengineers.com

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1.0 INTRODUCTION AND FACILITY INFORMATION

Ninety-First Avenue Renewable Biogas LLC (Ameresco) proposes to permit and install a digester gas treatment system and "tail" or waste gas flare at the 91th Avenue wastewater treatment plant (WWTP), operated by City of Phoenix (City). The digester gas treatment system, referred to as the Biomethane Plant (Plant), will produce a pipeline quality gas. The flare will act as a control device to destructively combust the tail gas from the Plant, along with the depress gas from the Plant startup and acid phase gas from the WWTP (when the Plant is operating).

This document represents Ameresco's application for an Air Permit for the Plant. Information required by the Maricopa County Air Quality Department (MCAQD) Air Pollution Control Regulations is presented in this document and its appendices. The Standard Permit Application Form and Emission Source Forms are presented in Appendix A.

The Plant will be located at the City's WWTP at 5615 South 91st Avenue, Tolleson, Arizona 85353. The approximate latitude and longitude are 33° 23' 39" North and 112° 14' 43" West. The entire Plant site is approximately 0.5 acre. A Site Vicinity Map is included as Figure 1. A Site Map showing the location of the Plant with respect to the WWTP complex is included as Figure 2. A Plant Process Equipment Plan showing the Plant major equipment and proposed configuration is included in Figure 3.

1.1 PLANT PROCESS DESCRIPTION

The Plant will treat the excess digester gas from the 91st Avenue WWTP and convert it to pipeline quality gas ("Biomethane Gas") that will be compressed and then transported through a 6-inch steel natural gas pipeline to the El Paso Natural Gas ("El Paso") interstate gas transmission pipeline located approximately two and one half miles west of the WWTP. The proposed Plant is based on using a Pressure Swing Adsorption ("PSA") process, which will convert the digester gas into pipeline quality gas by removing and concentrating the inert components and some methane into a tail gas stream. The Plant includes the PSA, all the auxiliary systems to support the operation of the PSA and a Tail Gas Flare. The Tail Gas Flare will combust the waste stream consisting of, PSA tail gas, PSA depress gas (during startup) and WWTP acid phase gas along with any supplemental fuel needed to startup and maintain the Tail Gas Flare operating temperature. These activities are described in detail in the following subsections.

1.1.1 Background

The WWTP is publicly-owned treatment works (POTW) that includes a system for the collection and control of digester gas generated from wastewater treatment activities. Currently, the digester gas is primarily burned in three flares or hot water boilers on site. However, with the proposed gas treatment facility, the excess digester gas will be converted into Biomethane through extensive gas treatment to remove inert components as oppose to being burned in the three flares. The WWTP will continue to combust digester gas in their boilers to generate the hot water needed for their digester tanks. The hot water boilers are expected to combust about 10% of the total digester gas generated.

In 2011, the WWTP modified their digestion process to a multiphase digestion process, which produces an acid phase and conventional digester gas stream. Based upon 2012 operating data, the acid phase gas consist of roughly 15% methane and an average of 11,536 parts per million by volume (ppmv) hydrogen sulfide (H2S) and a peak of 20,600 ppmv H2S. The conventional digester gas consist of roughly 61% methane and an average 207 ppmv H2S and a peak of 631 ppmv H2S. The 2012 average flow of conventional digester gas was 2,025 standard cubic feet per minute (scfm); the acid phase gas flow was 99 scfm. It is currently anticipated the conventional digester gas will be treated by the Biomethane Process and the acid phase gas will be sent directly to the Tail Gas Flare when the Plant is operating.

The WWTP air quality permit (Permit to Operate [PTO] No. 970580), which is dated April 29, 1999 and last revised on May 27, 2014, includes three enclosed digester gas flares (rated 80 MMBtu/hr) and four boilers (two rated at 12.55 MMBtu/hr and two at 20.92 MMBtu/hr.) The permit includes other miscellaneous point sources.

Under Condition #1 of this permit, the WWTP has a site-wide limit for sulfur oxides (SOx) on a rolling 12 months basis. Per condition #2, the City performs monthly calculations (using average monthly ppmv and total digester gas combustion) to update their rolling 12 month number each month. Condition #3 has a limit on combustion: 180 MMft3/month and 1650 MMft3 annually, the maximum quantity the anaerobic digesters can produce, and an 800 ppmv limit on H2S concentration for any unit greater than 10 MMBtu/hr using waste derived fuel (this is from Rule 323, but excludes flares, so this would not apply to the Tail Gas Flare). Condition #4 has weekly fuel sulfur testing requirements using American Society for Testing and Materials (ASTM) Method D5504-01 or equivalent method.

The proposed gas treatment process will produce a continuous tail gas stream when operating and intermittent depress gas streams during startup of compressors. The depress stream flows are less 200 scf over a 2 minute period. These streams will include similar contaminants as those found in the raw digester gas.

Ameresco is proposing a specially designed Tail Gas Flare that will be properly sized to accommodate the expected flow and composition of tail gas, depress gas and acid phase gas flow from the WWTP, and any supplemental gas necessary to ensure proper oxidation/destruction of the residual methane and volatile organic compounds (VOC's).

1.1.2 PSA Process

The PSA Process Equipment (Guild Associates Inc., or equivalent) consists of a compression, filtration, and solid media adsorption system designed to specifically prepare digester biomethane to meet pipeline gas quality specifications. The system shall be capable of automatic regeneration utilizing pressure-swing adsorption method. An integrated control system designed for easy operator operation and easy field installation is included. The digester biomethane is processed in the following sequence of steps:

1. Inlet digester gas water cooling followed by feed compression using oil-flooded screw compressors to approximately 100 pounds per square inch (psig),
2. Discharge gas water cooling to remove the bulk of the moisture in the compressed gas,

3. PSA treatment to produce pipeline quality gas (tail gas routed to the Tail Gas flare),
4. Odorization of Gas
5. Gas compression using a reciprocating compressor to pipeline pressures.

This process shall be capable of starting up in recirculation mode, without venting methane to the atmosphere.

1.1.3 Tail Gas Flare System

The Tail Gas Flare will act as a control device and will destructively combust the off-gas from the PSA Process. The flare is guaranteed to achieve a minimum non-methane organic compound (NMOC) control efficiency of 98 percent. The flare will be an enclosed biomethane flare with automated operations and designed for the variable composition expected in the tail gas stream. The system is controlled with a programmable logic controller (PLC) which receives and transmits signals based upon real time operating conditions to keep the system properly functioning. The PLC will discontinue flow of the biomethane when the operational conditions are outside of accepted normal ranges prior to operational problems occurring.

1.2 PRODUCT DESCRIPTION

The Plant is a biomethane treatment facility which will collect and treat gas generated from the City WWTP. The treated gas will consist of Biomethane to meet pipeline quality gas. No products are manufactured at the facility.

1.3 ALTERNATE OPERATING SCENARIOS

An alternative operating scenario is not planned for this project and is not include in this application.

1.4 PROCESS FLOW DIAGRAMS

A process flow diagram that depicts typical operations at the Plant is presented in Figure 4.

1.5 MATERIAL BALANCES

Mass balance calculations were not used for estimating emissions sources, therefore no information is provided here for this source. All emission-related information is presented in Section 2.0.

1.6 PROCESS AND CONTROL EQUIPMENT

The Plant will use a PSA Process to convert the conventional digester gas into Biomethane Gas in a single step. The inert gas and any contaminants will be collected and combusted in the Tail Gas Flare. This flare will be the only air emission point source for the Plant. The Interconnecting Pipeline will start at a connection point downstream of the Plant. The Interconnecting Pipeline will be a six inch high pressure steel pipe that is protected by a cathodic protection system. The Interconnecting Pipeline will include valves and other necessary appurtenances. The

Interconnecting Pipeline will run approximately 2.8 miles from the 91st Ave WWTP to the El Paso Metering Station and interconnect with the existing El Paso interstate natural gas transmission pipeline. As previously stated, an enclosed flare will be used to destroy the waste gas, or tail gas from the PSA Process and will combust the acid phase gas from the WWTP. The enclosed flare is guaranteed to achieve a minimum NMOC control efficiency of 98 percent.

1.6.1 PSA Process Equipment

The PSA Process Equipment will consist of biomethane feed compressor skids, PSA Unit media vessels and valves, product gas compressor skids, buffer vessels, and piping and valves skid to treat and move the gas through the process. A skid-mounted control system to sequence the system and allow for unmanned operation will be included and mounted on the end of the main PSA skid. This control system allows all the items to communicate and operate in an integrated fashion. The skid packages for the feed compressors, product compressor and vacuum skids have their own remote PLC that communicates via an Ethernet, low voltage wiring.

The design for the feed compressors skids includes skid-mounted electrically driven oil-flooded screw compressors, a feed separator, electric drive motors, product gas separator, water-cooled heat exchangers for cooling the gas and oil, and a discharge gas preheater using the hot oil from the compressors. Control is by locally mounted PLCs and communicates with the main PLC mounted on the PSA skid through an Ethernet field installed connection. The PLC will provide the ability to maintain minimum inlet pressures and monitor all critical system parameters such as lubrication oil pressure, safety switches and temperatures. Ancillary equipment include in this design are carbon steel moisture knock out vessels with drains and particulate filter (inlet only), demister, high liquid level shut down switches and piping systems designed for outdoor unattended operations. The design conditions are as follows:

The PSA Unit is designed to treat up to 4.32 million standard cubic feet per day (MM SCFD) of biomethane and produce 2.57MM SCFD of pipeline quality gas. The operating principal of the system is the relative capacity to adsorb Carbon Dioxide (CO2) (along with water and certain contaminants including Siloxanes and H2S) at high-pressure and the subsequent ability to release the CO2 and contaminants at low pressure. The PSA Unit consists of the following major components:

- Adsorber vessels,
- Valve and piping skid containing the valves and instrumentation to automatically sequence the PSA system. The valves and instruments are well proven and are readily available for replacement or repair.
- Vacuum pumps,
- Multiple buffer tanks to be placed near the main skid with piping required as part of the installation between the skid and each tank.
- An Allen-Bradley PLC based control system to operate the equipment. The control system is mounted on the main valve and piping skid.
- An operator PC-based HMI system for operation.

The treated gas will be compressed to pipeline pressure using equipment on the product compressor skid. The skid has been designed to include a gas compressor with an electric drive, water to gas

cooler and local PLC controls system with Ethernet connectivity. The PLC will provide the ability to maintain inlet pressures and monitor all critical system parameters such as lubrication oil pressure, safety switches, cylinder discharge temperatures and cylinder discharge pressures.

Buffer vessels have also been included in the design to minimize gas composition variability, gas flow rate fluctuations, and pressure fluctuations during the treatment of the gas. These vessels also help prevent pressure relief venting of the gas.

The system is sequenced by a shop fabricated valve and piping skid. The skidded equipment is designed for outdoor unattended operation and contains piping, valves and instrumentation.

1.6.2 Tail Gas Flare System Equipment

This Tail Gas Flare will be an enclosed flare system and will consist of an enclosed stack for the combustion of the tail gas, acid phase gas, propane for pilot and pipeline quality gas or digester gas for supplemental fuel. A buffer tank will be used to minimize tail gas variability and pressure fluctuations.

Tail Gas volume at full output of the PSA is expected to be about 1,243 scfm. Due to the low methane composition of the tail gas, this flare system has been designed for supplemental natural or digester gas to startup the Tail Gas Flare and bring it to its minimum operating temperature of 1400 F prior to injecting any waste gas. The initial supplemental fuel flow would be approximately 8 MMBtu/hr, but after its minimum operating temperature is reached, this flow rate will continue to decrease as needed to maintain a specific operating temperature. During normal operations, we expect that 0.7-1 MMBtu/hr of supplemental fuel gas will be needed to maintain operating temperature.

Additionally, acid phase gas from the WWTP will also flow to the flare for combustion. The flow rate of the acid phase gas is roughly 65 scfm with methane concentration of approximately 15%.

The flare has been conservatively sized for 26.1 MMBtu/hr maximum heat release based upon the combined flows from the PSA Tail Gas, PSA depress gas, WWTP acid phase gas and supplemental fuel. The flare design criteria is included in Appendix C.

1.7 STACK INFORMATION

There is one stack planned for the Plant which is the Tail Gas Flare. Tail gas from the PSA Unit and acid phase gas from the WWTP will be sent to an enclosed flare for combustion. Data for the flare is presented below:

- Manufacturer: To be Determined
- Stack Height: 50 feet
- Stack Diameter: 6 feet
- Capacity: 26.1 MMBtu/hr LHV

2.0 EMISSIONS INFORMATION

Pollutants that will be emitted from this project include criteria pollutants [carbon monoxide (CO), oxides of nitrogen (NO_x), sulfur dioxide (SO_2), particulate matter ($PM_{10}/PM_{2.5}$), volatile organic compounds (VOCs), and hazardous air pollutants (HAPs)]. The source for these emissions will be the combustion products of the tail gas from the PSA Unit, the Acid Phase Gas from the WWTP, and the supplemental pipeline quality fuel or digester gas combusted to maintain the flare's operating temperature. Section 2.1 provides details on these emissions. The methodologies for estimating emissions are presented in Section 2.2. Detailed flare emissions calculations are presented in Appendix B. These emissions calculations include the criteria pollutants as well as the greenhouse gases with the total carbon dioxide equalvant.

The operation of the Plant will result in an overall reduction of criteria pollutants as well as a reduction in carbon dioxide emissions compared to the current process of flaring and boiler combustion of the WWTP digester gas. The Plant's technology for treating the WWTP digester gas and producing a biomethane product will significantly reduce emissions from current operations.

2.1 DESCRIPTION OF CONTROL DEVICE

2.1.1 PSA Process Equipment

The PSA Process consists of a compression, filtration, gas odorizer and solid media adsorption system designed to treat the digester biomethane gas to meet pipeline gas quality specifications. As described in Section 1.6.1 the equipment is interconnected and will operate under vacuum and pressure conditions within sealed piping and pressure vessel systems to contain process emissions. Additionally, the PSA process is equipped with buffer vessels to smoothen gas flow and pressures during the treatment of the gas and prevents routine process venting. No stack or process emissions points are included in the PSA Process.

2.1.2 Tail Gas Flare System Equipment

Impurities entrained in the tail gas from the PSA process will be sent to the Tail Gas Flare for combustion along with the Acid Phase Gas from the WWTP. The destruction will result in the controlled emissions of VOCs, HAPs and emissions of PM_{10}, NO_x, SO_2, and CO.

Controlled emissions of VOCs and HAPs were estimated using 98 percent destruction efficiency which is the based upon the flare manufacturer destruction guarantee. Emissions of CO, NO_x, SO_2, and PM_{10} were estimated using the following emission factors:

Table 1. Enclosed Flare Emission Factors

Pollutant	Emission Factor	Source
CO	0.2 lb/MMBtu	Flare Manufacturer
NO_x	0.06 lb/MMBtu	Flare Manufacturer
SO_2	1,386 ppmv	Engineering Calculations, Appendix B weighted average
PM_{10}	17.00 lb/MMscf	AP-42, Table 2.4-5

2.1.3 Vehicle Traffic

The use of paved and unpaved roads by site vehicles and third party onsite vehicles may generate particulate matter emissions. Due to the small size of the site, these roads will be very short distances but will be treated with gravel or ground asphalt to control dust emissions. If required by Rule 310, a Maricopa County Dust Control Plan will be prepared and followed during the operating life of this project.

2.1.4 Condensate Management

The collection and evaporation of condensate can generate emissions of VOCs. However, the design and operation of this plant is to collect and contain condensate within the process vessels and return these liquids to the head waters of the WWTP for processing. Therefore, no additional emissions from the condensate management at the Plant are expected, and the overall emissions are already accounted for in WWTP emissions. Any emissions impact from condensate management at the Plant is considered insignificant.

2.1.5 Insignificant Activities

Several activities at the Plant are considered insignificant which may be conducted. These activities are described below, and are operational and maintenance which are not expected to impact and/or cause potential emissions of regulated air pollutants or are listed in Maricopa County's Insignificant List include:

- Brazing or welding equipment
- Normal landscaping, building maintenance or janitorial activities
- Hand-held or manually operated equipment used for aerosol can spray painting, buffing, polishing, carving, cutting, drilling, machining, routing, sanding, sawing, surface grinding

2.2 EMISSIONS CALCULATION METHODOLOGY

Emissions calculations estimating the total potential to emit (PTE) for Biomethane Plant were prepared, and the following subsections describe the methods used to estimate emissions.

2.2.1 Tail Gas Flare System Equipment

Controlled emissions of VOCs, and HAPs were estimated using 98 percent destruction efficiency. Emissions of CO, NO_x, SO_2, and PM_{10} were estimated using the emission factors found in Table 1 above.

2.2.2 Emissions Controls

As previously stated, the controlled emissions of VOCs and HAPs were calculated based on the enclosed flare minimum 98 percent destruction efficiency, with the HAPs emissions being insignificant based upon laboratory testing data.

No other identified sources at the facility require the installation of control equipment.

2.3 SUMMARY OF EMISSIONS

The methods previously described in the section were used to estimate the total PTE resulting from applicable processes at the Plant. These calculations are summarized in Table 2. Complete calculations (including sample calculations) are presented in Appendix B.

Table 2. Plant-Wide Potential to Emit

Pollutant	Primary Operating Scenario	
	lb/hr	tons/year
$PM_{10}/PM_{2.5}$	1.64	7.19
CO	5.22	22.86
NO_x	1.57	6.86
SO_2	44.80	WWTP limit
VOCs	4.33	18.94

3.0 COMPLIANCE INFORMATION

3.1 MAJOR SOURCE STATUS (RULE 240)

A stationary source is classified as a major source if the facility's PTE (excluding fugitive emissions) exceeds the major source thresholds for any criteria pollutant. Major source thresholds are listed in MCAQD Rule 240. Based on current attainment classifications, the applicable major source thresholds are listed in Table 3 and compared to the Plant's PTE. As demonstrated in Table 3, the Plant is a not major source.

Table 3. Major Source Status Determination

Pollutant	Major Source Threshold (tons/year)	PTE (tons/year)	Comments
$PM_{10}/PM_{2.5}$	70	7.19	PM10 Non-attainment
CO	250	22.86	Attainment
NO_x	50	6.86	Ozone Non-attainment
SO_2	100	WWTP limit	Voluntarily Limit
VOCs	25	18.94	Ozone Non-attainment

Note that since the Plant is not a major source for any criteria pollutants, it cannot be a major source for greenhouse gases (GHGs).

3.2 BEST AVAILABLE CONTROL TECHNOLOGY (BACT) APPLICABILITY (RULE 241)

The proposed emission levels for the Tail Gas Flare would be based on the "achieved in practice" BACT for flares and will comply with the MCAQD BACT guidance (July 2010). The new flare will be an enclosed flare and will be designed for 26.1 MMBTU /hr (which includes PSA tail gas, PSA depress gas, acid phase digester gas and supplemental fuel). We propose that the Tail Gas Flare be individually permitted from the Non-Title V Permit No. 970580 issued to the 91st Avenue WWTP. The permits for the Tail Gas Flare and for the 91st Avenue WWTP will share the same allowable SOx emission limitation, and both plants will combine their SOx emissions to meet this limit. The site wide SOx emissions will stay under the City's 12 month rolling average limit, and will include the emissions from the existing boilers, flare, IC engines and other sources as well as this proposed flare. The WWTP uses ferric chloride addition which reduces digester gas sulfur content, and has been successfully used to maintain the SOx limit for the existing flares and boilers. In 1998, MCAQD accepted the position that the ferric chloride addition met BACT since it demonstrated a significant reduction in SOx emissions.

Based upon Rule 241, the BACT thresholds and the expected emission rates from the Plant are listed in Table 4.

Table 4. BACT Thresholds and Potential to Emit Emission Rates

	BACT Threshold		PTE Emissions	
Pollutant	lb/day	tons/year	lb/day	tons/year
CO	550	100	125.28	22.86
NOx	150	25	37.58	6.86
$PM_{10}/PM_{2.5}$	85	15	39.42	7.19
SOx	150	25	1075.27	WWTP Limit
VOCs	150	25	103.81	18.94

Under these criteria, the proposed flare emissions are below BACT levels for CO, NOx, PM and VOC but exceeds for SOx. The actual SOx emission levels will vary based on the following three variables: (1) the amount of sulfur in the raw digester gas, (2) the percentage of that sulfur that can be removed and will end up in the tail gas, and (3) how efficiently the reduced sulfur compounds in the tail gas can be converted into SOx. The SOx emission levels for the Plant will never be higher than what the SOx levels would have been when the raw digester is burned in the current flares and boilers. The Plant will not increase SOx emissions as compared to the WWTP so we are proposing that the City's permit limit be considered as a combined limit covering the Tail Gas Flare as a specific unit as well as the existing flares and boilers. The Plant will routinely monitor the inlet H2S concentration to ensure that the City's shared limit is maintained. Additionally, should the WWTP air permit be modified in the future the plant will accept the new SOx limit.

3.3 DUST CONTROL PLAN (RULE 310)

Rule 310 establishes requirements for the control of fugitive dust. Pursuant to Rule 310, the Plant will maintain a Dust Control Plan and submit the plan to MCAQD as required in Rule 310.

3.4 HAZARDOUS AIR POLLUTANT APPICABILTY (RULE 372)

Rule 372 establishes standards for major sources of HAPs and minor sources of HAPs that are part of source categories. The rule is applicable to the following facilities:

- Sources that emit or have the potential to emit with controls ten tons per year or more of any HAP or twenty-five tons per year or more of any combination of HAPs; or

- Sources that are within a category designated pursuant to Rule 372 and that emit or have the potential to emit with controls one ton per year or more of any HAP or two and one-half tons per year of any combination of HAPs.

Biomethane treatment facility are not included as source categories listed in Rule 372 and emissions of HAPs from the Plant do not exceed the 10/25 ton thresholds. Therefore, Rule 372 does not apply to the Site.

3.5 COMPLIANCE PLAN

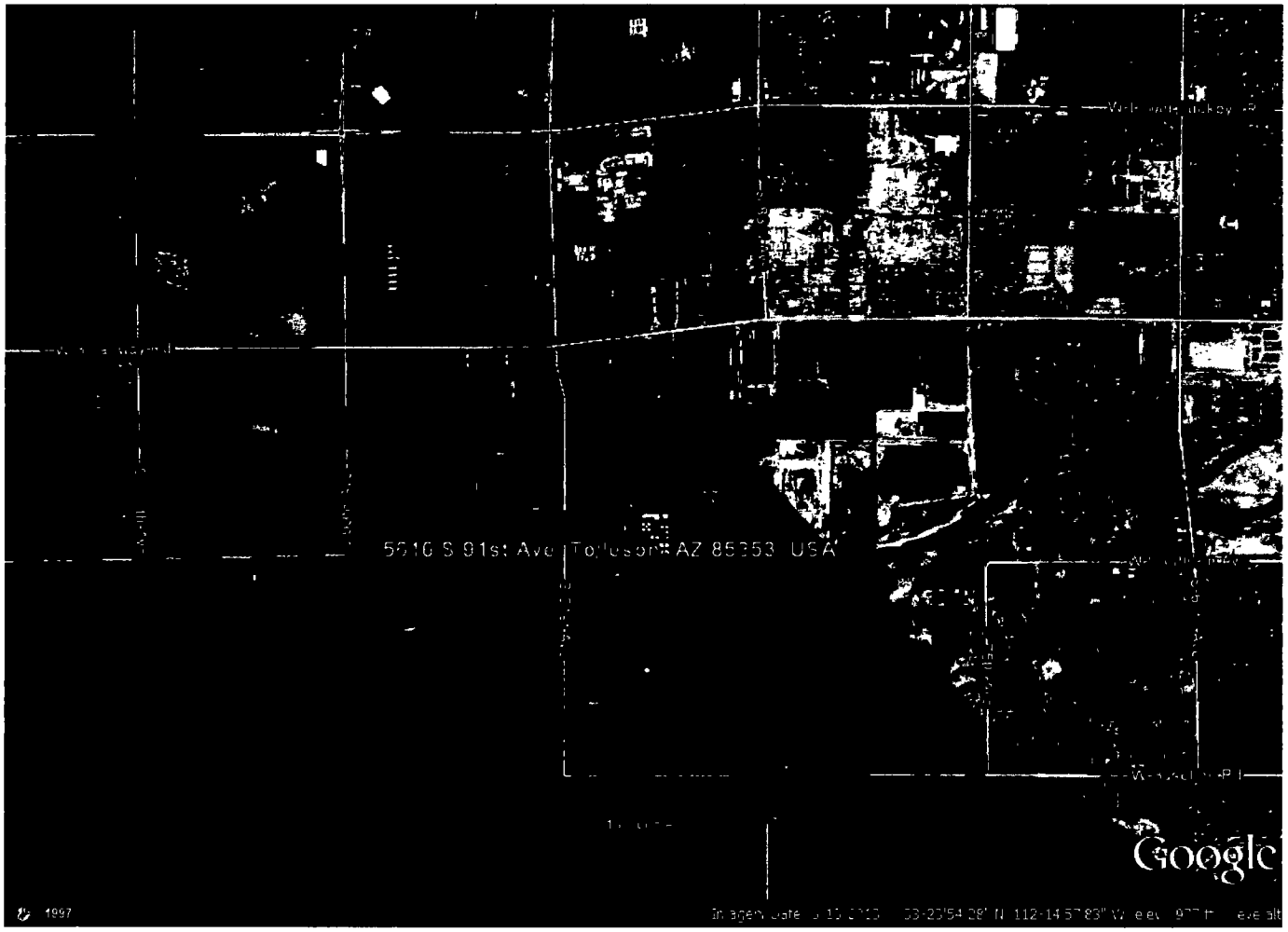
3.5.1 Compliance with Applicable Requirements

A regulatory analysis for the Plant is included in Appendix D. The regulatory analysis contains a compliance demonstration for applicable monitoring, reporting, recordkeeping, and test method requirements.

3.5.2 Voluntarily Accepted Limits and Proposed Exemptions

The Plant is seeking to voluntarily accept a SOx emission limit consistent with the WWTP permit. The Plant will not increase SOx emissions over the City's levels. Thus we are proposing that the WWTP permit limit be considered as a shared limit that includes the Tail Gas Flare as a specific unit. Additionally, should the WWTP air permit be modified in the future the plant will accept the new SOx limit.

Figures



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APPROXIMATE SCALE IN MILES

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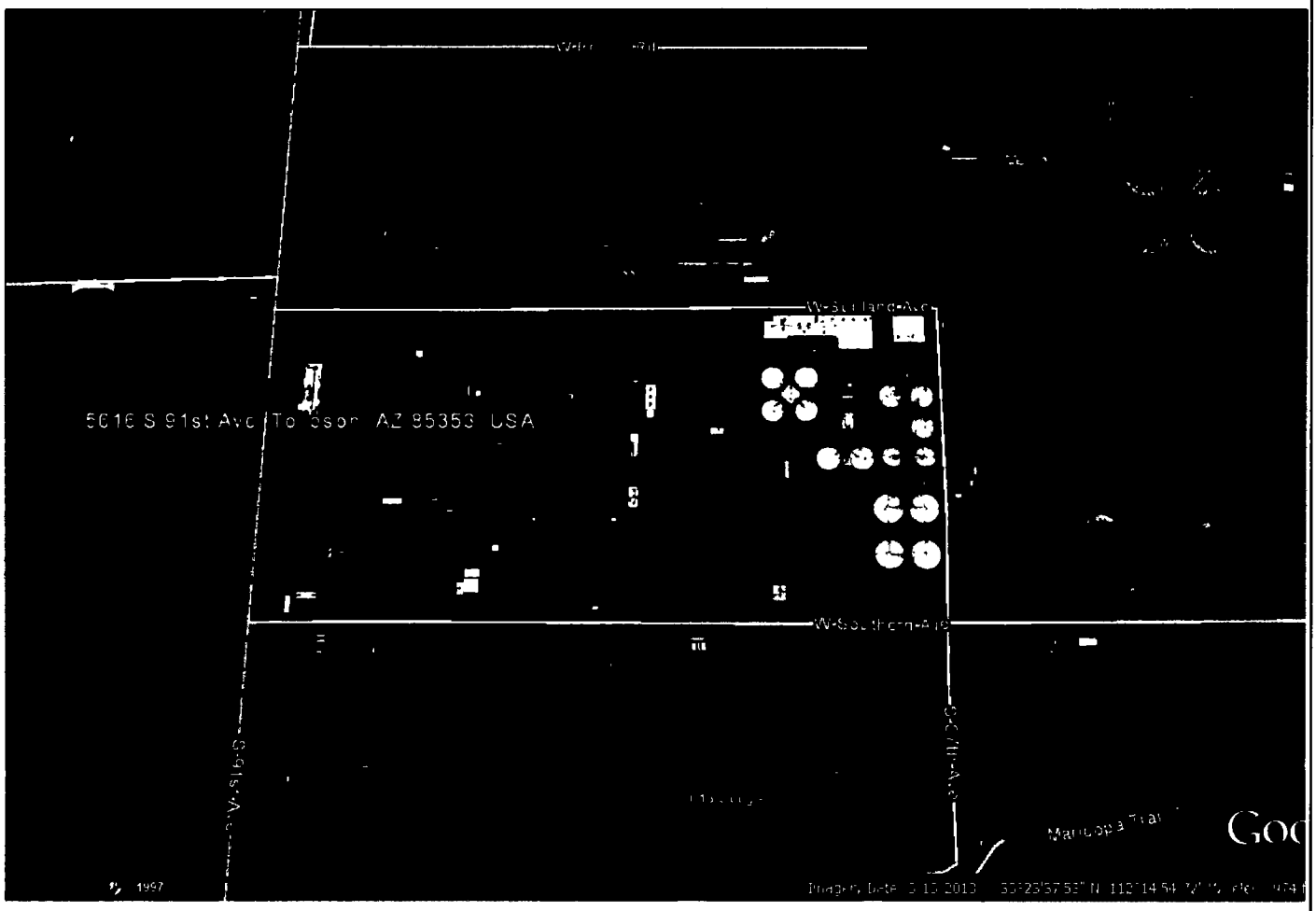


Figure 2
Site Map within the
City of Phoenix Waste Water
Treatment Complex

RevNo	Revision note	Date	Signature	Checked
A	–	–	–	
B	–	–	–	
C	–	–	–	

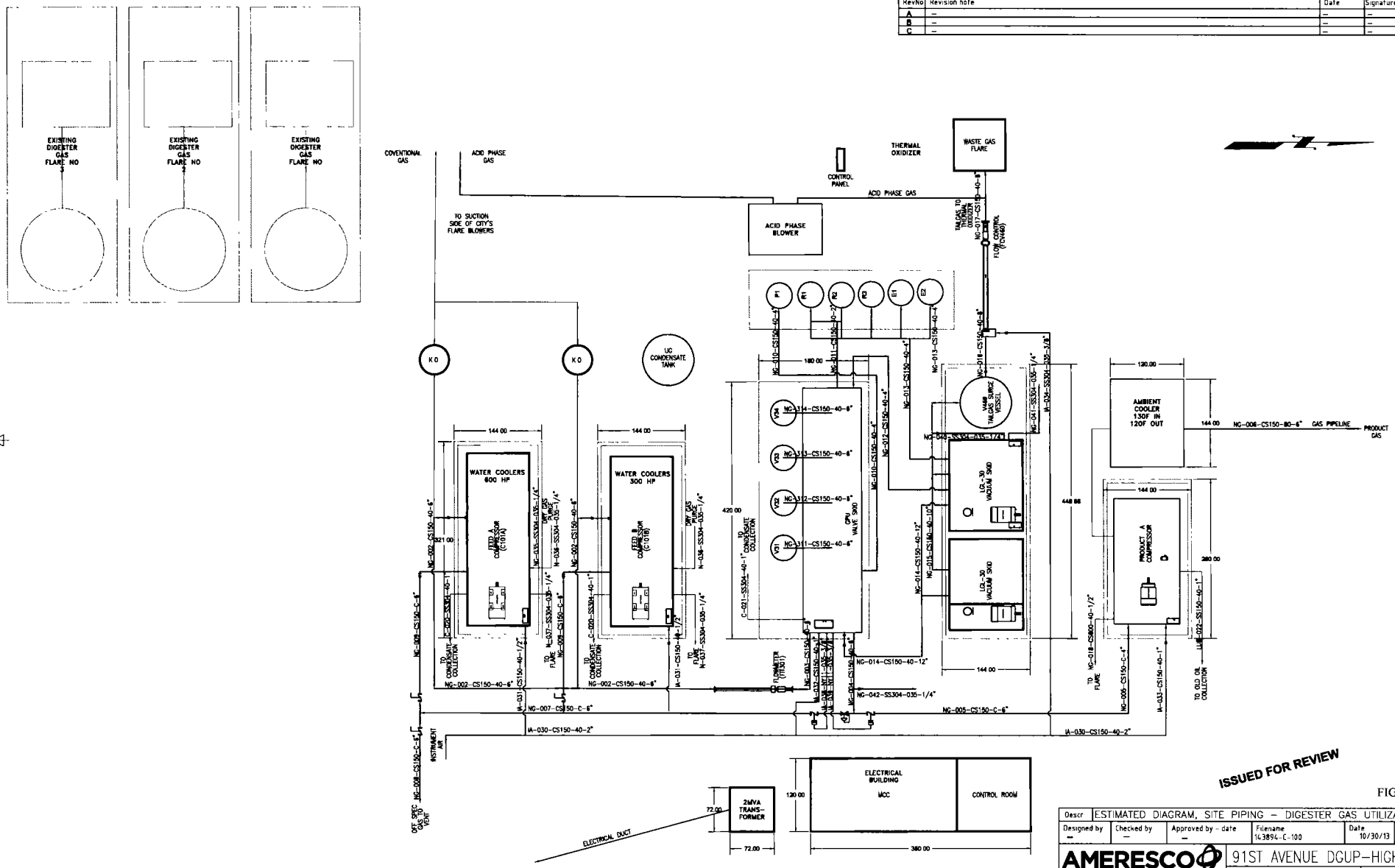


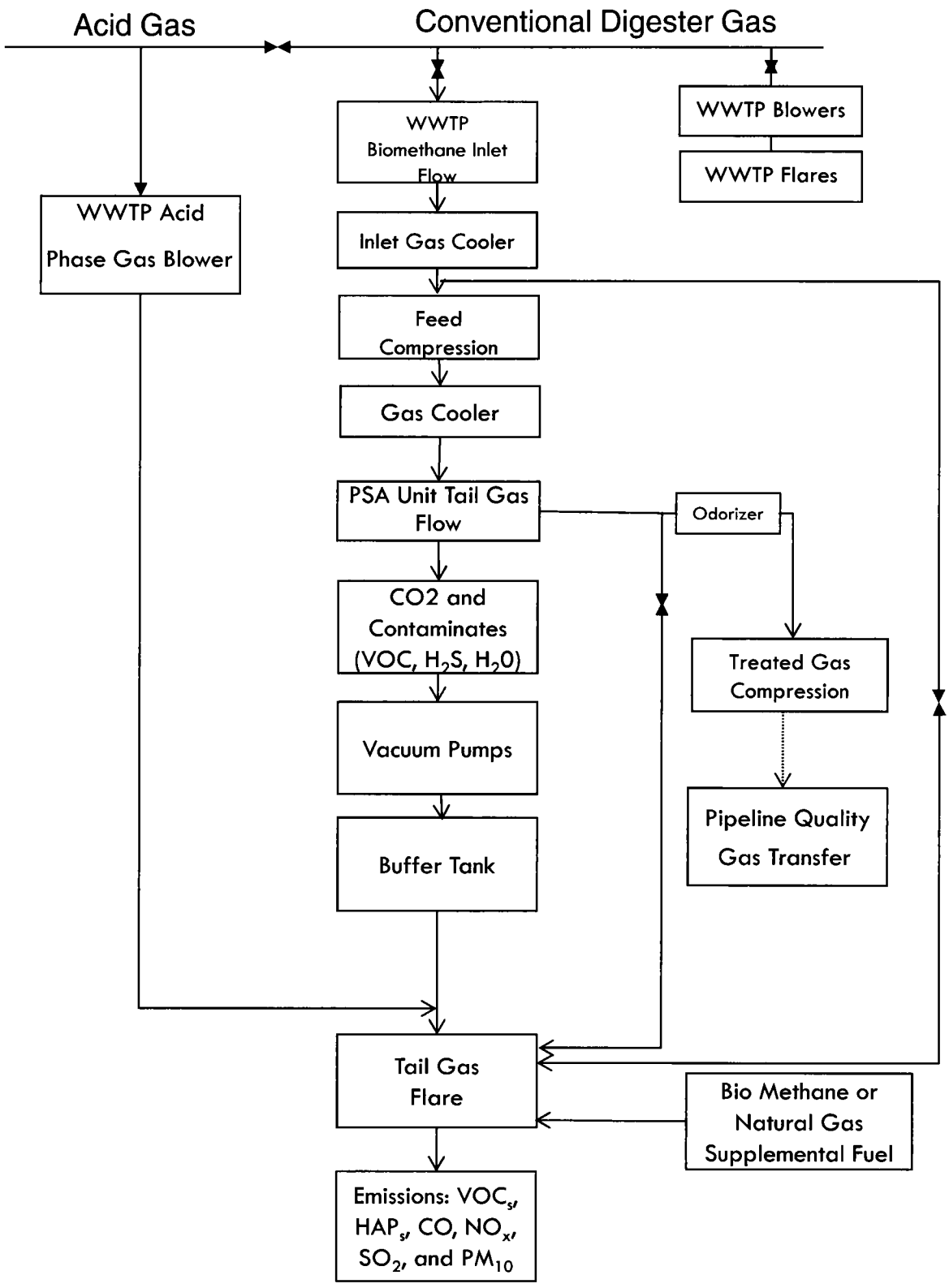
FIGURE 3

Descr	ESTIMATED DIAGRAM, SITE PIPING – DIGESTER GAS UTILIZATION				
Designed by –	Checked by –	Approved by – date	Filename 143894-C-100	Date 10/30/13	Scale NTS

AMERESCO Green · Clean · Sustainable

91ST AVENUE DGUP–HIGH BTU

Revision – | Sheet 1 OF 1



[1] Acid Phase Gas will be combusted in Tail Gas Flare but not processed in Biomethane Plant

Appendix A

Standard Permit Application Forms

RECEIVED

OCT 15 2015

MARICOPA COUNTY
AIR QUALITY DEPARTMENT

Maricopa County

Air Quality Department

Return completed form to:
Maricopa County Air Quality Department
1001 N Central Ave, Suite 125, Phoenix, AZ 85004
Phone (602) 506-6010 Fax (602) 372-0587
AQPermits@mail.maricopa.gov

NON-TITLE V PERMIT APPLICATION

APPLICATION FOR THE AUTHORITY TO OPERATE AND/OR CONSTRUCT A NON-TITLE V OPERATION

As required by A.R.S. §49-480 and Maricopa County Air Pollution Control Regulations, Rule 200)

ALL APPLICANTS MUST COMPLETE THE ENTIRE APPLICATION

Important: Please note that email will be our primary means for routine communication with you, unless you do not have an email account. Please be sure that your email address is entered correctly.

1. Business Name (as filled with the Arizona Corporation Commission): Ninety-First Avenue Renewable Biogas LLC

2. Is this a portable source? ☐ Yes (If yes, provide the current site information in items 2a, 3 and 3a) ☒ No (Complete items 2a, 3, and 3a)

2a. Address of site: 5615 South 91st Avenue

City: Tolleson | State: AZ | Zip Code: 85353

2b. Parcel # 101-33-004 | LOOKUP AT: http://mcassessor.maricopa.gov/Assessor/ParcelApplication/Default.aspx

3. Contact Person at Site: Sarah Simon

4. Type of Ownership: ☒ Corporation ☐ Sole Owner ☐ Partnership ☐ Government ☐ Other - Specify:

5. Name of Ownership or Legal Entity: Ninety-First Avenue Renewable Biogas LLC

Address: 111 Speen Street, Suite 410

City: Framingham | State: Massachusetts | Zip Code: 01701

6. Ownership Contact: Sarah Simon | 6b. Fax: | 6a. Telephone: 763-218-6038

7. Send All Correspondence Including Invoice And Permit To:
Company Name: Ninety-First Avenue Renewable Biogas LLC
Address: 111 Speen Street, Suite 410
City: Framingham | State: Massachusetts | Zip Code: 01701
ATTN: Sarah Simon

8. SIC (Standard Industrial Classification) or NAICS (North American Industry Classification) Code(s): 4925

9. Is this a renewal application? ☐ Yes ☒ No
If yes, enter the existing air permit number for this site:

10. If this application is submitted as a renewal application, has the ownership of this facility changed since the permit was last issued or transferred. ☐ Yes ☒ No

11. Brief Description Of Business Or Process At Site: Proposed Biomethane Plant to produce pipeline quality gas

12. Operating Schedule: Hours Per Day: 24 | Days Per Week: 7 | Weeks Per Year: 52

13. Projected Start-Up Date (New Facilities):

14. The authorized contact person regarding this application is:
Name: Dave Bearden | Telephone: 602-708-9815
Title: Senior Project Advisor | Fax:
Company: SCS Engineers | E-mail: dbearden@scsengineers.com

15. I certify that I am familiar with the operations and equipment represented on this application and attachments and the information provided herein is true and complete to the best of my knowledge.
Signature of owner or responsible official of business:
Type or Print Name and Title: Joe DeManche, Executive Vice President
Date: 10-15-2015

Permit number: 150120

By Ameresco, Inc., sole member of Ninety-First Avenue Renewable Biogas LLC.

18. OPERATION & MAINTENANCE (O&M) PLAN(S). O&M Plans are required for any process that vents emissions through a control device and includes both add-on control type equipment or processes whose controls are integrated into the design of the process equipment. Indicate if your facility has such control devices. (The list below is not an all-inclusive list of control devices.)

Equipment	No	Yes	How Many?
Baghouse	☐	☐	_____
Dust Collector/Filter	☐	☐	_____
Incineration System (e.g., catalytic or thermal oxidizer, afterburner, boiler, process heater, flare) – Specify: _____	☐	☐	_____
Scrubber	☐	☐	_____
Adsorption Unit (e.g., resin, carbon filter, other) - Specify: _____	☐	☐	_____
Absorption Unit	☐	☐	_____
Other - Specify: Enclosed Flare	☐	■	One

If you checked YES to any of these boxes, attach a separate O&M Plan for each control device. The O&M Plan should describe key system operating parameters and appropriate operating ranges for these parameters. For new equipment or processes, provide an educated estimate of the ranges of any parameters to be monitored. These ranges should be supported with manufacturer's test data or other manufacturer's data from engineering calculations and/or experience with the equipment. In addition, O&M Plans should be prepared in accordance with Maricopa County Air Quality Department - Operation and Maintenance (O&M) Plan Guidelines. A copy of these guidelines can be obtained at: http://www.maricopa.gov/aq/divisions/permit_engineering/docs/pdf/OMGuidelines.pdf or by contacting the Permits Program Coordinator at (602) 506-6094. Multiple control devices can be combined in a single O&M Plan providing they are identical in type, capacity, and use. A separate O&M Plan is required for each device that is unique in type, capacity, or use.

19. DUST CONTROL PLAN. The owner and/or operator of a dust-generating operation shall submit to the Control Officer a Dust Control Plan with any permit applications that involve dust-generating operations with a disturbed surface area that equals or exceeds 0.10 acre (4,356 square feet). Facilities subject to Rule 316: Nonmetallic Mineral Processing are also required to submit a Dust Control Plan.

Requirement	No	Yes	Disturbed Surface Area ≥ 0.10 Acre	Subject to Rule 316
Dust Control Plan	■	☐	☐	☐

For further guidance completing the dust control plan, review the "Guidance For Dust Control Permit For Application" document located at http://www.maricopa.gov/aq/divisions/compliance/dust/docs/pdf/DustControlPlanStationarySource.pdf or contact the Dust Compliance Division at (602) 506-6010

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19. APPLICABLE SECTIONS. Review each section of the application and mark below which sections apply to this facility. In the final application, submit only those sections that apply to this facility. Note that Section Z must be completed by all applicants.

- ☐ A Fuel Burning Equipment
- ☐ B Internal Combustion Engines & Turbines
- ☐ C Petroleum Storage Tanks
- ☐ D Water & Soil Remediation
- ☐ E-1 Spray Painting & Other Surface Coating (excluding vehicle and wood coating)
- ☐ E-2 Vehicle & Mobile Equipment Coating
- ☐ F Woodworking and Wood Coating Operations
- ☐ G Solvent Cleaning
- ☐ H Plating, Etching & Other Metal Finishing Processes
- ☐ I Dry Cleaning Equipment
- ☐ J Graphic Arts
- ☐ K-1 Concrete Batch Plants
- ☐ K-2 Non-Metallic Mineral Mining and Processing
- ☐ K-3 Asphalt Production
- ☐ K-4 Non-Metallic Mineral Processing (continued)
- ■ L Other Dust-Generating Operations
- ☐ M Abrasive Blasting
- ■ X-1 Point Source Emissions of Hazardous Air Pollutants
- ☐ X-2 Non-Point Area Emission Sources for Hazardous Air Pollutants
- ■ Y Other Sources
- ■ Z Air Pollution Emissions

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SECTION L. OTHER DUST GENERATING OPERATIONS

This section is intended for all dust-generating operations not coverred elsewhere in the permit application.

1. Are routine dust-generating operations performed at this facility that disturb a surface area of 0.10 acre or greater? ☐ Yes ■ No
2. How many acres of disturbed land are located at this facility? <0.1
3. Are any unpaved parking lots located at this facilitiy? ■ Yes ☐ No
4. Are any unpaved haul/access roads present at this facility? ■ Yes ☐ No
5. If the answer to item 4 is "yes", how many vehicle trips are made daily on each unpaved road? 10
6. Are bulk materials handled, stored or transported at this facility? Bulk materials include, but are not limited to: non-metallic minerals, soil, demolition debris, cotton, trash, saw dust, feed, grain, fertilizers, fluff from shredders, dry concrete, or any other material that is capable of producing fugitive dust. ☐ Yes ■ No
7. If the answer to item 6 is "yes", list the type and amount (tons per year) of bulk material(s) handled, stored and/or transported:
   a. _____ c. _____
   b. _____ d. _____
8. Are any blasting operations using explosives performed at this facility? ☐ Yes ■ No
9. Are any open storage piles located at this facility? ☐ Yes ■ No
10. If the answer to item 9 is "yes", how many acres do the storage piles cover?
11. Do you have any unpaved staging or material storage areas? ☐ Yes ■ No
12. Do you have any easements, rights-of-way or access roads for utilities (transmission of electricity, natural gas, oil, water, or gas)? ☐ Yes ■ No
13. Briefly describe how trackout is controlled at exits from unpaved roads at this facility that lead to paved areas accessible to the public.

Gravel and/or ground asphalt will be applied to unpaved roadways. Final design of the plant site is pending and may be <0.1acres.

14. Submit a dust control plan with this application if this facility is involved in dust-generating operations that equal or exceed 0.10 acre (4,356 square feet). Include the following:
   a. Name(s), address(es), and phone numbers of person(s) responsible for the submittal and implementation of the dust control plan and responsible for the dust-generating operation.
   b. A drawing, on 8½" x 11" paper, that shows entire project site/facility boundaries, acres to be disturbed with linear dimensions, nearest public roads, north arrow, and planned exit locations onto paved areas accessible to the public.
   c. Appropriate control measures, or a combination thereof, for every actual and potential dust-generating operation.
   d. One contingency control measure must be identified for all dust-generating operations.
   e. The maximum number of vehicle trips on unpaved haul/access roads each day (including number of employee vehicles, earthmoving equipment, haul trucks, and water trucks).
   f. Dust suppressants to be applied, method, frequency, and intensity of application; type, number, and capacity of application equipment; and information environmental impacts and approvals or certifications related to appropriate and safe use for ground application.
   g. Specific surface treatment(s) and/or control measures utilized to control material trackout and sedimentation where unpaved roads and/or access points join paved areas accessible to the public.

For further guidance completing the dust control plan, review the dust control plan document located at: http://www.maricopa.gov/aq/divisions/compliance/dust/PermitPackage.aspx or contact the dust compliance division at (602) 506-6010.

SECTION X-1. POINT SOURCE EMISSIONS OF HAZARDOUS AIR POLLUTANTS

Completion of this section is mandatory for all source categories with a primary SIC code listed in MCAQD Rule 372, Table 1, and for all other facilities which will have an actual hazardous air pollutant (HAP) emission rate of any single federal HAP above the hourly or annual *de minimis* level specified in Rule 372, Table 2. Rule 372 may be found at: http://www.maricopa.gov/aq/divisions/planning_analysis/rules/docs/372-0706.pdf

Source Equipment Name (1)	HAP Name and/or CAS Number (2)	HAP Emission Rate		Stack or Point Discharge Parameters (5)								
						Building Dimensions			Distance from Stack to Nearest Property Line (ft)	Stack Exit Data		
		(lb/hr) (3)	(tons/yr) (4)	Stack ID	Stack Height Above Ground (ft)	Building Length (ft)	Building Width (ft)	Building Height (ft)		Diameter or Length x Width (ft)	Velocity (fps)	Temp (°F)
Flare	See App. B-2	<0.002	<0.009	Flare	50	NA	NA	NA	3,000	6	NA	1,400

General Instructions:

(1) Identify each federal hazardous air pollutant (HAP) emission source and each HAP associated with that emission source for the entire plant site. Use as many lines as necessary for each HAP source.

(2) Refer to the list of federal HAPS on the last page of the application.

(3) Pounds per hour (lb/hr) is actual emission rate estimated or measured by applicant to be vented through stack.

(4) Tons per year is actual annual emission rate estimated or measured by applicant to be vented through stack, which takes into account process operating schedule.

(5) Supply additional information as follows on a separate sheet if appropriate:
Stack exit configuration other than a round vertical stack. Show length and width for a rectangular stack. Indicate if discharge is horizontal.
Show layout of adjacent structures if structure is within 3 times stack height above the ground.

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SECTION Y. OTHER SOURCES

This section is intended for all emissions related activities, equipment and applicable emission controls which are not covered in previous sections. In response to item 2, provide a detailed step-by-step narrative, including how raw materials are handled, stored, processed, mixed, treated, and converted to finished products. Provide flow rates, temperatures, pressures, and other appropriate details concerning each process. Whenever available, provide manufacturer's data sheets and literature. Provide flow diagrams and layouts for each process. Describe in detail how waste materials are generated, handled, stored, processed, mixed, treated and disposed of. An Operation and Maintenance Plan for each air pollution control equipment is required. List each material that is partially recovered, salvaged or otherwise reclaimed. Provide estimates of the quantities of such material recoveries on an annual basis. Describe how the annual quantity figures were developed. USE A SEPARATE SHEET FOR EACH PROCESS OR ACTIVITY.

1. Name of Process, Equipment Grouping or Activity: Tail Gas Flare

2. Narrative description:
An enclosed flare which combusts impurities and tail gas from a biogas treatment process along with acid phase gas from a waste water treatment plant.

3. EQUIPMENT LIST. Include machinery, storage silos, tanks, emission control devices, etc., in this list.

Assigned Equipment Number	Describe each Piece of Equipment Include Make & Model	Date of Installation or Modification	How Many	HP, KVA Gallons or Other Ratings (Specify Units)	Exhaust - Vent to Air	Exhaust - Vent to Control (Identify)
1	Enclosed Flare	Pending	1	26.1MMBtu/hr	Yes	

4. Material List. :List all materials handled, stored, processed, used, mixed, treated, or emitted from the facility, including but not limit to chemicals, mixtures, resins, cleaning compounds, etc. Identify each material in sufficient detail and provide material safety data sheets (MSDS) for each material.

Material	Annual Usage or Throughput (gal/yr or lb/yr)	Chemical Composition (% by weight)	Material Reclaimed or Shipped as Waste (gal/yr or lb/yr)	Equipment Number in Which Used
Tail Gas from Treatment Process	653.3 MMscf/yr	See Note 1	None	1
Note 1: CH4=13%, CO2=80%, N2=7%				
WWTP Acid Phase Note 2: CH4=15%, CO2=77%, N2=8%	52.0 MMscf/yr	See Note 2	None	1
Supplemental Fuel-Bio/Nat Gas Note 3: CH4=60-100%,	13 MMscf/yr	See Note 3	None	1

5. Describe Control Devices CO_2= 40-0%, N_2 < 1%

Type of Device	Name/ID/Capacity	Equipment Controlled[1]	Date of Installation	Control Efficiency[2] (% Weight)
Enclosed Flare	Tail Gas Flare/1/26.1MMBtu/hr	No	Pending	>98

[1] Specify the equipment number from item 3 for the piece of equipment whose emissions are being controlled by the control device.
[2] Provide written documentation of control efficiency (e.g., manufacturer's data or source test data). Attach the manufacturer's specifications and drawings for each air pollution control device listed. Be sure that the locations of all flow devices and pressure/ temperature gauges are indicated. Attach an operation and maintenance plan for each piece of control equipment listed above.

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SECTION Z. AIR POLLUTANT EMISSIONS

Provide a summary of the projected actual air emissions on an annual basis for the entire site in the following summary tables. Attach detailed calculations to support the figures. **If supporting calculations are not included with the application, the application will be deemed incomplete.**

Pollutant	Emissions (lb/yr)
Carbon Monoxide (CO)	45,720
Oxides Of Nitrogen (NO_x)	13,720
Oxides Of Sulfur (SO_x)	WWTP Limit
Particulates Of 10 Microns Or Smaller (PM_{10})	14,380
Total Suspended Particulates (TSP), Including PM_{10}	14,380
Volatile Organic Compounds (VOCs)[1]	37850
Lead	0
Federal hazardous air pollutants (list each one separately):	
[1]VOCs are defined by EPA at: http://www.epa.gov/ttn/naaqs/ozone/ozonetech/def_voc.htm	

Do not include the emissions from motor vehicles. Include the emissions from stationary sources, portable sources, test areas, experimental facilities, evaporative losses, storage and handling losses, fuel loading and unloading losses, etc. Specifically identify the following in detailed calculations:

1. Emissions From Each Point Source And Each Stack
2. Capture Efficiencies
3. Control Efficiencies
4. Overall Efficiencies
5. Fugitive Emissions
6. Non-point (area) Emissions

For particulate (dust) emissions, describe the types of particulates being emitted and the quantities of emissions for each type. Whenever a material is identified by a trade name, also provide its generic name and its chemical abstract service (CAS) number.

Help sheets for calculating emissions from specific industries or processes can be obtained at:
http://www.maricopa.gov/aq/divisions/planning_analysis/emissions_inventory/instructions.aspx

If you need help completing the application package, please see our website or contact 602-506-5102.
http://www.maricopa.gov/aq

Appendix B

Emissions Inventory for

Tail Gas Flare

APPENDIX B-1
POTENTIAL TO EMIT EMISSION INVENTORY FOR ENCLOSED TAIL GAS FLARE
91st AVENUE BIOMETHANE PLANT
PHOENIX, ARIZONA

Criteria Air Pollutants	Molecular weight[2]	Inlet Compound Concentration (ppm_v)[3]	Pollutant Flow Rate to Flare (tons/yr)	Destruction Efficiency (%)[4]	Maximum Emissions from Flare (lbs/hr)[15]	Maximum Emissions from Flare (lbs/day)[16]	Maximum Emissions from Flare (tons/yr)[17]
VOCs[1]	86 18	5000 00	947 23	98 00	4 33	103 81	18 94

Criteria Air Pollutants	Molecular Weight (g/Mol)	Rep. Concentration of Compound (ppmm)[11]	Emission Factor (lb/MMft^3)[12]	Emission Factor (lb/MMBtu)[7]	Maximum Emissions from Flare (lbs/hr)[15]	Maximum Emissions from Flare (lbs/day)[16]	Maximum Emissions from Flare (tons/yr)
Nitrogen Oxides (NO_X)[6]				0 06	1 566	37 58	6 86
Carbon Monoxide (CO)[6]				0.20	5 22	125 28	22 86
Sulfur Dioxide (SO_2)--ppm_m Max[9,10]	64 10	1642.19			44 80	1075 27	WWTP Limit
Particulate Matter (PM_{10})/$PM_{2\,5}$[12]			17 00		1 64	39 42	7 19

Greenhouse Gases		Maximum Annual Flow[3] (scf)	Heating Value[4] (mmBtu/scf)	Emission Factor (kg/mmBtu)[5]	Maximum Emissions from Flare (lbs/hr)[15]	Maximum Emissions from Flare (lbs/day)[16]	Maximum Emissions from Flare (tons/yr)
Carbon Dioxide (CO_2)[14]		1,692,868,975	0 000135	52 07	6 80E-04	0 02	13,125 77
Methane (CH_4)[14]				3 20E-03	4 18E-08	1 00E-06	0 81
Nitrous oxide (N_2O)[14]				6 30E-04	8 22E-09	1 97E-07	0 16
Total Carbon Dioxide Equivalent (CO_2e)[13]					6 83E-04	1 64E-02	13,195 17

[1] VOC Pollutant Flow Rate to Flare [tons/year] = (Molecular Weight of Compound[g/mol])*(Concentration of Compound[ppmv]/1,000,000)* (Flare Maximum Design Flow Rate [cfm]) *(525,600 min/yr)*(1 ton/2,000 lb)* (1 lb/453 6 g)*(1 mol/24 04 L @ STP)*(28 32 L/1 cf)

[2] Molecular weight of VOC (as hexane) of 86 18 g/mol and of SOx = 64 1 g/mol

[3] Inlet concentration of VOC is a conservative estimate, and selected based upon process knowledge and expected concentrations

[4] Based on the flare design destruction efficiency of 98% for VOCs

[5] Flare maximum design flow rate is 3346 cfm based on expected maximum operating conditions

[6] NOx and CO Emissions (tons/year)=Emission Factor (lb/MM BTU) x Flare Capacity (MM BTU/hr) x 8760 hr/year x 1 ton/2000 lb

[7] NOx and CO emission factors from vendor specifications and typical BACT levels

[8] Flare capacity is based on maximum expected heat input on LHV conditions (26 1 MM BTU/hr)

[9] Note that the permit application proposes a voluntary site SOx emission limit based upon the SOx limit for the 91st Ave WWTP air quality permit This limit is a shared limit with the WWTP Additionally, should the WWTP air permit be modified in the future the plant will accept the new limit The short term hourly and daily emissions are uncontrolled which are affected by WWTP process fluctuations

[10] SO_2 Flare Emissions = ppm_m H2S [lbs/day] = Conc, ppm_m*Flare Design Flow Rate [MMcf]* Permit Factor (0 075 lbs/cf)*Ratio SO_2 to H_2S (64/34) from current City permit

[11] ppmm = ppmv x (32/27) per direction from Mancopa County AQD Expected average ppmv value is 1385 6 ppmv derived from site data

[12] EF from AP42, Table 2 4-5 and calculated with 50% methane as a conservative estimate

[13] The CO2e [tons/year] was calculated with CH_4 and N_2O converted to CO_2e using 25 and 310, respectively, as their global warming factors, and summed with the CO_2

[14] EPA MRR calculation methodology (40 CFR 98 Subpart HH) and emission factors were used to calculate GHG emissions

[15] Maximum Flare Emissions [lbs/hr] = emissions from flare [tons/year] * 2000 lbs/ton * Flare Operating Hours [hours/year] / 8,760 hours/year

[16] Maximum Flare Emissions [lbs/day] = maximum emission [lbs/hr] * 24 Flare Operating Hours [hours/day]

[17] Maximum Flare Emissions [tons/yr] = flow rate to flare [tons/year] x (1-Destruction efficiency [%])

[18] All calculations assume flare is operating continuously (24 hours/7 day/52 weeks)

[19] Site specific heat value as calculated based on methane having a heat value of 1020 multiplied by the methane content Heat value recommended by COP

[20] Note HAPs are insignificant as show on Table B2

MODEL INPUT VARIABLES BASED ON TAIL GAS AND SUPPLEMENTAL:			Tail Gas	Supplemental
Methane Content[19]	13 24	%	12 2	65
Average Flow Rate to Flare	811	SCFM	1243	25
Maximum Flow Rate Based on Rating-LHV[5]	3,221	SCFM		
Maximum Flare Rating-LHV[8]	26.1	MMBtu/hr	9 28	15 51

APPENDIX B-2
PHOENIX BIOMETHANE PLANT
POTENTIAL TO EMIT EMISSIONS INVENTORY HAPS

Emission Sources:

Enclosed Flare

Pollutant	Molecular Weight (g/Mol)	Average Concentration Found In Digester Gas (ppmv) (2)	HAPs Tail Gas to Flare (tons/yr) (3)	Control Efficiency (4)	Emissions from Flare (tons/yr) (5)
Hazardous Air Pollutants (HAPs) (1)					
1,1,1-Trichloroethane (methyl chloroform)	133.41	0.00	0.000	98%	0.00E+00
1,1,2,2-Tetrachloroethane	167.85	0.00	0 000	98%	0.00E+00
1,1-Dichloroethane (ethylidene dichloride)	98.97	0.00	0.000	98%	0 00E+00
1,1-Dichloroethene (vinylidene chloride)	96 94	0 00	0.000	98%	0 00E+00
1,2-Dichloroethane (ethylene dichloride)	98.96	0.00	0.000	98%	0 00E+00
1,2-Dichloropropane (propylene dichloride)	112 99	0 00	0.000	98%	0.00E+00
Benzene	78.11	0.00	0.000	98%	0 00E+00
Carbon disulfide	76.13	0 00	0.000	98%	0 00E+00
Carbon tetrachloride	153 84	0 00	0.000	98%	0 00E+00
Carbonyl sulfide	60.07	0.52	0.070	98%	1.40E-03
Chlorobenzene	112.56	0 00	0.000	98%	0.00E+00
Chloroethane (ethyl chloride)	64.52	0.00	0.000	98%	0 00E+00
Chloroform	119.39	0.00	0.000	98%	0.00E+00
Chloromethane (methyl chloride)	50.49	0.10	0 011	98%	2.27E-04
Dichlorobenzene (1,4-Dichlorobenzene)	147.00	0.00	0.000	98%	0.00E+00
Dichloromethane (Methylene Chloride)	84.94	0.00	0.000	98%	0.00E+00
Ethylbenzene	106 16	0 13	0 031	98%	6.20E-04
Ethylene dibromide (1,2-Dibromoethane)	187.88	0.00	0.000	98%	0.00E+00
Hexane	86 18	0 20	0.039	98%	7.74E-04
Methyl isobutyl ketone	100.16	0.00	0.000	98%	0 00E+00
Toluene	92.13	0 26	0.054	98%	1.08E-03
Trichloroethylene (trichloroethene)	131.40	0 00	0.000	98%	0.00E+00
Vinyl chloride	62.50	0.00	0.000	98%	0 00E+00
Xylenes	106.16	0.78	0.186	98%	3.72E-03
Carbonyl sulfide - Highest Single HAP	60.07	0.52	0.0701	98%	1 40E-03
Total HAPs	--	--	0.39	--	0.0079

NOTES.

(1) Listed Hazardous Air Pollutants (HAPs) are among compounds commonly found in digester gas as identified by Analytical Solutions, Inc, Willowbrook, IL.

(2) HAP concentrations tested by Analytical Solutions, Willowbrook, IL, 10/18/13; 91st Ave WWTP Digester Gas #1 & 2 sampled 9/30/13.

(3) Based on the flare flow rate*(1/methane content)*Molecular Weight *compound concentrations) and conversions show below in sample calculation.

(4) Based on the flare design destruction efficiency of 98% for organics and 0% for sulfur compounds.

(5) (Tail Gas to flare)*(1-control efficiency)=flare emissions

MODEL INPUT VARIABLES

Estimated Methane Content of LFG	13%
Flare Flow based on 26.1MMBtu/hr	3,221 scfm

EXAMPLE CALCULATIONS

(HAPs, VOCs)

Gas Flow Rate [scfm] = (Flare flow rate [m3/yr])*(1/Estimated Methane Content)*(35 3147 cf/m3)/(525,600 min/year)

Gas Generation [tons/year] = (Molecular Weight of Compound[g/mol])*(Concentration of Compound[ppm]/1,000,000)*(Flow Rate [cfm])*(525,600 min/yr)*(1ton/2,000lb)*(1lb/453 6g)*(1mol/24 45L @ STP)*(28 32L/1cf)

Gas To Flare [tons/year] = flow rate [tons/year] x Collection efficiency [%] * Flare Operating Hours [hours/year] / 8,760 hours/year

Emissions From Flare [tons/year] = (Gas To Flare [tons/yr])*(1 - Control Efficiency)

Appendix C

Tail Gas Flare Manufacturer Design Criteria and Equipment Scope

April 20, 2015

Via Email: drobinson@ameresco.com

Ameresco
9855 West 78th Street, Suite 310
Eden Prairie, MN 55344

Attention: Mr. Dean Robinson

Subject: Firm Proposal for Low BTU Enclosed Flare
91st Ave. WWTP – Phoenix, AZ
John Zink Proposal BF-201210-30465, rev.09

Dear Dean,

Thank you for your recent interest in John Zink Company services and products. We appreciate the opportunity to assist you with the flare portion of your project. To satisfy your gas flare requirements per your recent request, John Zink Company is pleased to offer a budget quote for our **Enclosed ZBRID System for Low BTU Gases.**

For over 80 years, the John Zink brand has provided quality, innovative technology, and worldwide service in the combustion industry. John Zink has supplied over 700 flare systems for the biogas industry and we possess the expertise and resources to ensure a successful flare project and reliable flare performance.

John Zink offers a range of features and options as listed in the following "Equipment Description" section. Our intent is to supply the safest, most reliable and economical system available that will also allow you to customize your system to meet your specific needs. After reviewing the proposal, please let us know if there are any additional options you would like to pursue.

We look forward to working with you on this project, and if you require any additional information please do not hesitate to contact me at 918.234.4760.

Sincerely,
JOHN ZINK COMPANY, LLC

Ryan Talley
Applications Engineer
Biogas Flare Division

DESIGN CRITERIA

Waste Gas Stream

Type:	Biogas
Composition:	11.7% CH4 Remainder CO2, air, inerts *20,000 ppmv H_2S*
Flow Rate:	1393 SCFM (maximum)
Temperature:	180 °F (max) 150 °F (avg)
Waste Heat Release (based on LHV):	**8.9 MM BTU/hr (maximum)**
Inlet Pressure:	20" H_2O (required at flare inlet)

Supplemental Fuel Gas Stream

Type:	Natural Gas or Digester Gas
Composition:	65% or 97% CH4 (maximum) Remainder CO2, air, inerts
Max Digester Gas Flow Rate:	390 SCFM (maximum)
Fuel Heat Release (based on LHV):	**13.9 MM BTU/hr (maximum)**
Inlet Pressure:	20" H_2O (required upstream of TCV)
Maximum Heat Release for Stack:	**26.1 MM BTU/hr (maximum)**

*The initial fuel needed to pre-heat the combustion chamber to a minimum 1500 F prior to injecting the waste gas stream is 8 MM Btu/hr, however the burner can take as much as 13.9 MMBtu/hr of fuel. After temperature is reached, this flowrate will continue to decrease as needed to maintain a specific operating temperature. During normal operations, we expect that 0.7-1 MM BTU/hr of supplemental fuel gas will be needed to maintain operating temperature.

Mechanical

Design Wind Speed:	110 mph
Ambient Temperature:	32 °F to 120 °F
Electrical Area Classification:	non-hazardous
Elevation:	1,150 feet above MSL

Process

Smokeless Capacity:	100%
Operating Temperature:	1400 °F to 1800 °F (2000 °F shutdown)
Retention Time:	0.7 seconds at 1800 °F (minimum)
Required Flame Arrester Inlet Pressure:	10" H_2O (maximum)
Ambient Pressure:	14.7 psia

Utilities

Pilot Gas (intermittent):	22 SCFH of propane at 7-10 psig (or) 50 SCFH of natural gas at 10-15 psig
Compressed Air:	None
Electricity:	120 V, 1 ph, 60 Hz
Auxiliary Fuel:	Natural Gas or Digester Gas

Expected Flue Gas

Operating Temperature	1600°F	1800°F
CO_2 Volume %	7.0	8.1
H_2O Volume %	8.2	9.2
N_2 Volume %	72.6	71.8
O_2 Volume %	12.2	10.9

Expected Emission Range (Design Flow)(1)

Operating Temperature	1400 – 1600 °F
Overall Destruction Efficiency(2)	98%
NOx, lb / MMBTU(3)	0.06
CO, lb / MMBTU(4)	0.20

(1) Expected emission rates at lower operating temperatures are available upon request.
(2) Typical sulphur containing compounds are expected to have greater than 98% oxidation efficiency.
(3) Excludes NOx from fixed nitrogen.
(4) Excludes CO contribution present in landfill gas.

NOTE: Expected emissions are based on field tests of operating units and the higher heating value (HHV) of the gas. Destruction efficiency, NOx, and CO emissions shown are valid for combustion of landfill gas only. Expected emissions are not guaranteed unless expressly stated in this proposal.

SCOPE OF SUPPLY

Item 1, Enclosed Flare (ZBRID)

- One (1) 6'-0" diameter x 50'-0" overall height, A-36 carbon steel flare stack enclosure.
- Two (2) 1" layers of *A.P. Green* (or equal) ceramic fiber refractory on Inconel pins and keepers for the top portion of the stack. The bottom portion of the combustion chamber will be lined with castable refractory to create a heat zone for superior combustion.
- One (1) stainless steel manifold assembly with 10" flanged inlet connection for the waste gas stream.
- One (1) stainless steel burner manifold assembly with 6" diameter flanged inlet connection for the fuel gas stream.
- One (1) Tru-Lite™ igniter assembly for use during start-up cycles. This externally mounted pilot provides simple operation and can be removed for maintenance without entering the stack.
- One (1) bolted blade combustion air damper with opposed blade design, providing air turndown control. Galvanized finish and stainless steel press-fit bearings ensure smooth, long term operation. A special, proprietary lower burner chamber design minimizes direct radiation on the damper for maximum service life.

  NOTE: *Removal of the damper allows access to the lower flare burner chamber and eliminates the need for a separate manway.*

- Two (2) 4" diameter NPT couplings with plug provided as sample ports at 90° apart located one-half stack diameter from the flare top for accurate emission testing.
  NOTE: *These ports can be accessed by use of a temporary device such as power-lift vehicle or permanent ladder and platform equipment (refer to the recommended optional equipment section for ladder and platform selection).*
- One (1) stainless steel rain cap consisting of overlapping tabs to provide weather protection at the refractory and flare shell interface.
- Four (4) thermocouple connections at various elevations for temperature monitoring.
- Exterior protection using SSPC-SP-6 sandblast, *Sherwin Williams* Zinc Clad II primer coating system, 4 mils DFT for superior corrosion protection at shell temperatures to 750 °F.
- One (1) AISC designed continuous base plate for high wind stability.
- Two (2) lifting lugs to assist in erection.
- Thermocouple conduit mounting brackets.

Miscellaneous Accessories

- Four (4) operating manuals (one (1) hard copy, three (3) electronic copies on CD) with essential operating instructions, appropriate vendor literature on instrumentation, and drawings.
- 400 ft of thermocouple extension wire.
- One (1) gallon of field touch-up paint.

Item 2, Automatic Ignition and Control Station Rack

- One (1) self-supporting steel rack for electrical panels to be attached to the front side and pilot gas piping and instrumentation attached to the rear side. Electrical panel and controls programming provided by others.

Stack Mounted Controls (shipped loose for field installation by others)

- One (1) combustion air damper to control the operating temperature. As part of the automatic temperature control feature, the damper is equipped with automatically controlled louvers.
- One (1) Ignition Panel Assembly including a transformer, pilot spark electrode, and ignition wire. The enclosure is stack mounted for easy access to the pilot assembly.
- One (1) purge air blower.
- One (1) high temperature shutdown thermocouple.
- Three (3) temperature monitoring thermocouples with location dependent on specific flow conditions. The operating thermocouple can be selected either automatically based on the flow rate or manually from the touch screen display.

Item 3, Inlet Flame Arresters

- One (1) 6" diameter, eccentric *Enardo* Flame Arrester with stainless steel housing, housing drain, and removable stainless steel internals mounted at the flare inlet on the auxiliary fuel line. Internal elements can be cleaned without removing the flame arrester body from the pipe.
- One (1) 8" diameter, eccentric *Enardo* Flame Arrester with stainless steel housing, housing drain, thermocouple at the inlet, and removable stainless steel internals mounted at the flare inlet on the tail gas line. Internal elements can be cleaned without removing the flame arrester body from the pipe.

Item 4, Two (2) Automatic Block Valves

- Two (2) automatic block valve assembles consisting of a butterfly valve and fail-closed pneumatic actuator. The valve has a carbon steel wafer body, 316 SS disk and shaft, and PTFE seal. The pneumatic actuator can be operated with either compressed air or compressed nitrogen from a cylinder. The 8" valve is for the waste gas (low BTU gas) stream. The 6" valve is for the fuel gas stream.

Item 5, Materials for High Tail Gas H_2S Concentration

- Piping and burner manifold fabrication from 304 stainless steel.
- Teflon seals for manual butterfly valves.
- Interior stack coating.
- Anti-corrosive/Rigidizer to protect stack refractory.

RECOMMENDED OPTIONAL EQUIPMENT

Item 6, Access Ladder

- One (1) galvanized, safety ladder providing access to thermocouples. Equipment includes a ladder, safety rails, a safety harness, and personnel protection screening behind the ladder and around the thermocouple ports. A lockable gate is available for an additional price.

Item 7, Service Platform

- One (1) galvanized, 150° service platform, designed per *OSHA* requirements, providing access to the stack sample ports. A continuous band of personnel protection screening around the sample ports is included with this option. A 360° service platform is available for an additional price.

Item 8, Flare Foundation Template

- One (1) enclosed flare base plate foundation template constructed of 1/4" carbon steel plate to assist in setting and installing the anchor bolts in the field. The template is shipped prior to the flare, so that it can be utilized at the time the flare foundation is formed.

Item 9, Control Panel Weather Hood

- One (1) fabricated steel hood designed to limit control panel exposure to the elements. It provides approximately 4' of overhang to the front and 2' to the rear. The hood is painted to match the rest of the control panel rack and comes with a fluorescent light assembly for enhanced visibility of the panel components at night.

Item 10, *Underwriters Laboratories* Classification

- John Zink Company is dedicated to ensuring the highest level of quality and safety standards in its products. This performance level is reflected in all products and provides the opportunity to apply the *UL* listing symbol for Industrial Control Panels on motor starters and a *UL* classification symbol on Flare Control Panels. This option is provided for applications requiring *Underwriters Laboratories* Certification.

Item 11, Booster Blower

- One (1) Booster blower to increase digester gas pressure at flare inlet to 10" WC, with Aluminum wheel, belt drive, low leakage construction, and 3-60-230/460V motor, and motor starter with Nema 4 enclosure.

Appendix D

Compliance with Applicable Requirements

Compliance With Applicable Requirements

Regulatory Citation	Regulatory Title	Applicable Requirement	Compliance Demonstration
CODE OF FEDERAL REGULATIONS			
None			
MARICOPA COUNTY AIR QUALITY DEPARTMENT (MCAQD) RULES			
Rule 100	General Provisions and Definitions	1. Requires inclusion of certification of truth, accuracy, and completeness with applicable documents. 2. Requires certain records to be kept for a minimum of five years. 3. Requires the submittal of an annual emissions inventory report.	1. Applicable documents include compliance certification statements. 2. Applicable records will be kept for a minimum of five years. 3. The Plant will submit annual emissions inventory reports by the due dates specified.
Rule 140	Excess Emissions	Establishes requirements and affirmative defenses for excess emissions.	In the unlikely event of an excess emission, the Plant will comply with the excess emissions recording and reporting requirements of the permit.
Rule 200	Permit Requirements	Requires operators to obtain, post, and renew air quality permits.	Upon issuance, the permit is posted on-site.
Rule 210	Title V Permit Provisions	Establishes procedures for obtaining a Title V permit, including application processing procedures, permit contents, permit review, compliance plan requirements, administrative requirements and public participation provisions.	Based upon the application is it anticipated that Title V permitting is not applicable for this source.

Compliance With Applicable Requirements

Regulatory Citation	Regulatory Title	Applicable Requirement	Compliance Demonstration
Rule 220	Non-Title V Permit Provisions	Establishes procedures for obtaining a Non-Title V permit, including application processing procedures, permit contents, permit review, compliance plan requirements, administrative requirements and public participation provisions.	Based upon the application is it anticipated that a non-Title V permit is applicable for this source.
Rule 270	Performance Tests	Establishes requirements for performance tests, testing criteria, testing conditions, notification of testing, and submittal of test protocols and reports.	As required, performance testing will be performed for the flare. The appropriate notifications, protocols, and test reports will be submitted as required.
Rule 280	Permit Fees	Requires payment of various fees.	The Plant will pay all fees and will continue to pay applicable fees in a timely manner.
Rule 300	Visible Emissions	Establishes an opacity limit of 20% with the exception of exceedances during startup, shutdown, and emergencies.	The Plant will apply reasonable control measures to maintain compliance with the opacity standard, such as gravel over unpaved roads or other approved practices.
Rule 310	Fugitive Dust	1. Requires a Dust Control Plan to prevent fugitive dust emissions. 2. Opacity from fugitive dust sources shall not exceed 20%.	Plant will follow a MCAQD-approved Dust Control Plan (Plan). Fugitive dust controls are implemented per the Plan. If required, Records of controls applied (such as water) are kept on site.
Rule 320	Odors and Gaseous Air Contaminants	Establishes requirements for facilities to limit emissions of odors and other gaseous air contaminants into the air.	The existing enclosed flare complies with minimum stack height requirements. The Plant equipment is designed to control odors by maintaining closed systems under pressure or vacuum conditions. Additionally, the process is equipped with surge vessels to control gas pressure and flow.

Compliance With Applicable Requirements

Regulatory Citation	Regulatory Title	Applicable Requirement	Compliance Demonstration
Rule 331	Solvent Cleaning	Establishes recordkeeping and reporting requirements for solvent cleaning operations.	The Plant will maintain a list of current VOC-containing solvents and/or MSDS (or equivalent) for VOC-containing solvents. The Plant will record the amount of VOC-containing solvent used. Where possible, the Plant will consider using low-VOC cleaners. The Plant will document the amount used for low-VOC cleaners via the MSDS or other vendor information.
Rule 353	Gasoline in Stationary Dispensing Tanks	Establishes requirements for gasoline storage tanks larger than 250 gallons.	The Plant does not have any gasoline storage tanks that are larger than 250 gallons.

Appendix E

Operation and Maintenance Procedures

Objective: This Appendix provides the key operation and maintenance (O&M) procedures for the Tail Gas Flare as part of an air quality permit. These procedures are intended to establish maintenance procedures and schedules to ensure that the facility is properly operated and maintained.

Applicable Equipment: Enclosed Tail Gas Flare

Design Basis: The flare offers unattended and automated operations, and is designed to destroy biomethane safely with automatic temperature control. The system is controlled with a programmable logic controller (PLC) which receives and transmits signals based upon real time operating conditions to keep the system properly functioning. The PLC will discontinue flow of the biomethane when the operational conditions are outside of accepted normal ranges prior to operational problems occurring.

Routine Maintenance Procedures:

Annual –

Visually inspect stack for deterioration and exterior surface for degradation.
Visually inspect flare tips for deterioration.
Visually inspect stack insulation for deterioration or damage.
Visually inspect thermal couple assemblies.
Visually inspect pilot assembly, ignition elements and insulators for damage.
Visually inspect flow meter and if required by manufacturers re-calibrate the unit
Clean flare detection components and vent port.
Test set points in PLC for proper alarm and shutdown set points.

Quarterly –

Visually inspect auto shutoff valve for proper operation, deterioration or damage.
Visually inspect pilot gas piping and pressure gauges.
Verify proper operation of louver dampers.
Read pressure drop across flame arrestor to verify it's within specification.
Verify safety settings in PLC for proper alarm and shutdown set points.
Visually inspect electrical enclosures, component and wiring for damage.

Monthly –

Verify proper PLC operations.
Verify data logging unit is properly operating and data transferred to file archives.